

Proposed Design of an Arduino-Based Sensor Interfacing System Using PCB Technology

Shankar Lal Ninama, Prashant Goyal

Department of Electronics and Communication Engineering,
Patel College of Science and Technology, Indore, Madhya Pradesh, India

ABSTRACT

This work presents the design and implementation of a simple electronic system using PCB design, Arduino interfacing, and sensor integration. The circuit schematic was designed using Express SCH, and the PCB layout was developed in Express PCB by following standard PCB design rules. The PCB was fabricated using the toner transfer and chemical etching method. The system uses an Arduino microcontroller for interfacing and control. Different sensors such as a PIR sensor, MQ6 gas sensor, and thermistor were connected for motion detection, gas detection, and temperature sensing. A Visual Basic 6 (VB6) interface was also developed for displaying sensor information on a computer. The work demonstrates the complete process of schematic design, PCB fabrication, hardware implementation, and software interfacing. The developed system is suitable for educational and prototype applications.

KEYWORDS: PCB, Arduino, Express SCH, Sensor Interfacing, Gas Sensor, PIR Sensor, Thermistor.

How to cite this paper: Shankar Lal Ninama | Prashant Goyal "Proposed Design of an Arduino-Based Sensor Interfacing System Using PCB Technology"

Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-10 | Issue-3, June 2026, pp.203-208, URL: www.ijtsrd.com/papers/ijtsrd102017.pdf



Copyright © 2026 by author (s) and International Journal of Trend in Scientific Research and Development Journal. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0) (<http://creativecommons.org/licenses/by/4.0>)



1. INTRODUCTION

This work focuses on the design and implementation of a simple electronic system using PCB design and sensor interfacing techniques. The schematic circuit was designed using Express SCH software, and the PCB layout was prepared using Express PCB. Standard PCB layout rules were considered during the design process. The PCB was fabricated using the toner transfer and chemical etching method. An Arduino microcontroller was used for interfacing and controlling different sensors. The system includes a PIR sensor for motion detection, an MQ6 gas sensor for gas detection, and a thermistor for temperature measurement. These sensors were connected with the Arduino for basic monitoring purposes. A simple software interface was developed using Visual Basic

6 (VB6) to display system information on a computer. The work includes schematic design, PCB development, hardware assembly, and software interfacing in a simple and practical manner. The developed system can be used for educational purposes, laboratory work, and prototype development. The situation in the wake of a disaster is often chaotic and disaster victims who have become trapped or otherwise incapacitated by the events surrounding them are for the most part fully reliant on the efforts of rescue workers. It is therefore vital to the lives of victims that the search and rescue operation happens as quickly and efficiently as possible.



Fig.1: Depicting disaster victims' images old (Source: Online images)

Several research works have been reported in the fields of embedded systems, wireless monitoring, sensor interfacing, robotics, and intelligent monitoring applications. Usha Tiwari et al. [1] developed a human rescue robot using IR and sound detection techniques for identifying human presence in disaster situations. Mauricio Correa et al. [2] proposed a human detection robot based on thermal and visual sensing methods for rescue applications. The CRASAR and KOHGA robotic systems [3] demonstrated the use of advanced sensing and robotic mobility for search-and-rescue operations, although these systems involved complex hardware structures and higher implementation costs. Shwetha R. et al. [4] presented a human detection robot using PIR sensors and GSM communication for temperature monitoring and alert generation. Mishra et al. [5] discussed the role of robotics in disaster management and emphasized the importance of automated systems in hazardous environments. These studies demonstrate the importance of sensor integration, wireless communication, and embedded control systems in monitoring and rescue applications.

Several technical resources and embedded development platforms have also contributed significantly to low-cost electronic system design. The ATmega328 microcontroller datasheet provided by Atmel Corporation [6] and ZigBee communication modules developed by Digi International [7] are widely used in embedded communication systems. Practical approaches to AVR and Arduino programming were discussed by Mazidi et al. [8], Simon Monk [9], and Charles Platt [10], which support hardware interfacing and PCB-based implementation techniques. Recent research by Nagar et al. [11] and Patidar et al. [13] demonstrated the application of intelligent monitoring systems in healthcare and safety applications. Other works including image processing, deep learning, and automation systems were presented by Singh et al. [12], Yadav et al. [14], Sarang et al. [15], Chauhan et al. [17], and Gupta et al. [18], showing the growing importance of intelligent embedded systems and automation technologies in modern engineering applications.

2. Literature Survey

Based on the limitations of previous systems such as high cost, complex implementation, bulky hardware, and dependency on advanced infrastructures, the proposed work titled “Design of an Arduino-Based Sensor Interfacing System Using PCB Technology” focuses on developing a simple and cost-effective embedded system. The proposed system integrates Arduino-based control with PCB fabrication and multiple sensors including PIR, MQ6 gas sensor, and thermistor for monitoring applications. The work also includes software interfacing for system monitoring and display. Compared to earlier methods, the proposed design offers simplified hardware architecture, easy implementation, and suitability for educational, laboratory, and prototype-level applications [6-10].

Table 1: Literature Survey

Author & Year	Method / Technology Used	Sensors / Communication	Key Features	Limitations	Novel Parameters in Proposed Work
Usha Tiwari et al. (2012)	Human Rescue Robot	IR Sensor, Sound Detection	Detects live humans using IR and sound	Limited accuracy in noisy environments	Zigbee-based wireless real-time monitoring
Mauricio Correa et al. (2012)	Human Detection Robot	Thermal Camera, Visual Sensors	Human identification using thermal and visual data	High computational complexity and cost	Low-cost embedded implementation

ROACH Robot System	Hexapod Rescue Robot	Camera, Audio Transmission	High mobility in rough terrain	Complex mechanical structure	Compact and energy-efficient design
KOHGA Snake Robot	Snake-like Rescue Robot	Camera and Crawlers	Access to narrow disaster spaces	Difficult control and high maintenance	Simple hardware architecture
CRASAR Robot (2001)	Search and Rescue Robot	Radar, CCD Camera, IR Camera	Used in real disaster scenarios	Expensive and bulky system	Portable and low-power system
Shwetha R. et al. (2014)	Human Detection Robot	AVR MCU, PIR Sensor, GSM	Human temperature sensing with SMS alert	GSM dependency and network issues	Zigbee mesh communication support
Burion Project	USAR Human Detection System	Pyroelectric Sensor, IR Camera, Microphone	Motion and heat-based human detection	Semi-autonomous operation	Fully automated wireless alert system
M.K. Mishra et al.	Robotics in Disaster Management	Surveillance and Mobile Robots	Assists rescue teams in risky areas	High implementation complexity	Cost-effective embedded automation

3. Proposed Systems

This unit consists of ATMEGA328 Microcontroller, L293D Motor Driver IC, ZigBee Module, motors of the robot & various sensors for detection of human presence as shown in the block diagram. ATMEGA328 is a single chip 8-bit AVR RISC-based microcontroller created by Atmel and belongs to the megaAVR series. It has 28 pins. It has flash memory of 32 Kbytes. ZigBee module is connected to PD0 and PD1 pins of the microcontroller i.e. data pins of ZigBee module are connected to RXD and TXD pins of microcontroller.

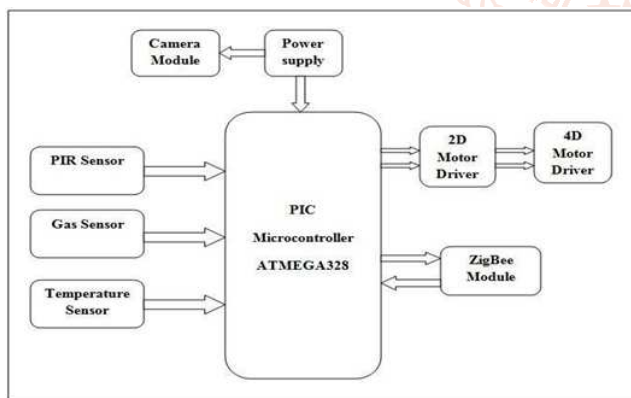


Fig. 2: Robot Unit

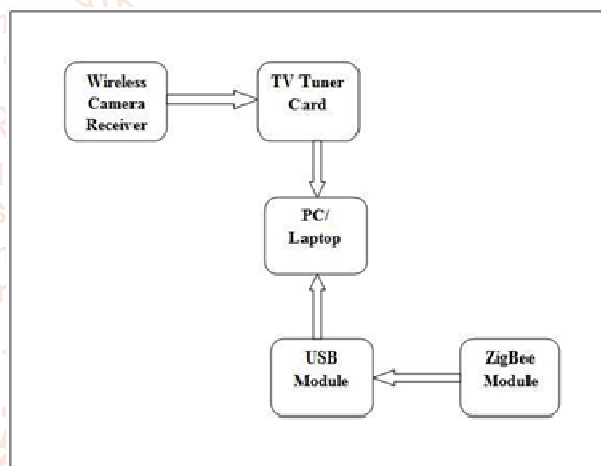


Fig. 3: Control Unit

4. Design Circuit Diagrams

In this chapter, we are discussed on different circuits of design our proposed model such as robot unit and power supply, Control Unit ZigBee USB etc.



Fig. 4: Robot Unit & Power Supply

- This unit consists of ATMEGA328 Microcontroller, L293D Motor Driver IC, ZigBee Module, motors of the robot & various sensors for detection of human presence as shown in the block diagram.
- ATEGA328 is a single chip 8-bit AVR RISC-based microcontroller created by Atmel and belongs to the megaAVR series. It has 28 pins. It has flash memory of 32 Kbytes.
- ZigBee module is connected to PD0 and PD1 pins of the microcontroller i.e. data pins of ZigBee module are connected to RXD and TXD pins of microcontroller. The two Vcc pins are shorted and connected to a supply of 5v. GND pins are shorted and connected to ground. The ZigBee module receives the data and transmits it to the microcontroller.

5. PCB LAYOUTS DESIGN

In this chapter, we are discussed the layout of PCB design such as robot unit (AVR328 & ZigBee Module), MQ6 Gas Sensor, Temperature Sensor-Thermistor and ZigBee Module & USB.

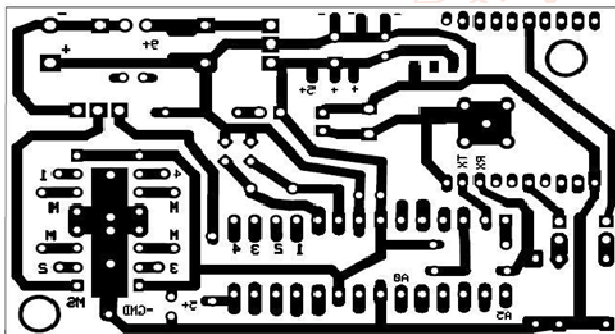


Fig. 5: AVR328 & ZigBee Module

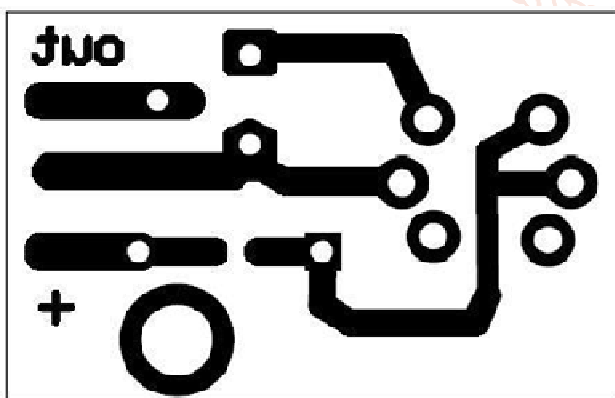


Fig 6: MQ6 Gas Sensor

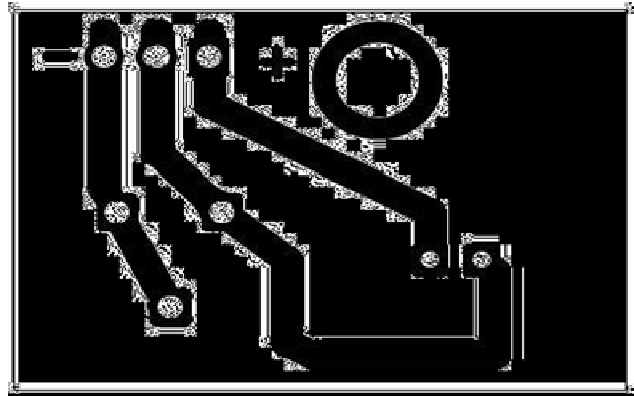


Fig. 7: Temperature Sensor-Thermistor

6. Control Unit

Digi XBee 3 USB Adapter provides local connectivity to wireless Digi XBee networks from a laptop or PC, enabling local commissioning of the network and its devices.

- Programmable to communicate with any of Digi's supported wireless protocols.
- Provides connectivity to local Digi XBee networks from a laptop/PC.
- Enables fast local commissioning of devices on the local network.
- USB powered.
- LEDs for UART traffic and network association.

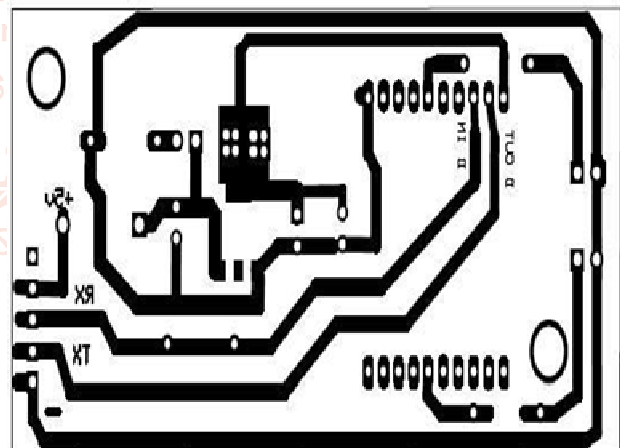


Fig. 8: ZigBee Module & USB

7. Conclusion

This work presented the design and development of a human detection and monitoring robot using an ATMEGA328 microcontroller, ZigBee communication, motor driver circuits, and different sensing modules. The proposed system was developed by considering the limitations of earlier rescue and monitoring robots such as high cost, complex hardware structure, communication dependency, and implementation difficulty.

The robot unit was designed using AVR-based embedded hardware along with ZigBee wireless communication for data transmission between the robot and control unit. Different sensors and modules were integrated for monitoring and detection purposes. PCB layouts for the controller section, ZigBee module, gas sensor, and temperature sensor were also designed and implemented successfully.

References:

- [1] Usha Tiwari, S. R. Bhadra Chaudhuri, and S. K. Ghosh, "Human Detection and Tracking Robot for Rescue Operations," *International Journal of Computer Applications*, vol. 52, no. 15, pp. 12–16, 2012.
- [2] Mauricio Correa, Javier Mondragón, and Carlos Parra, "Human Detection for Mobile Rescue Robots Using Thermal and Visual Information," *International Conference on Robotics and Automation*, pp. 345–350, 2012.
- [3] Robin R. Murphy, *Disaster Robotics*, MIT Press, Cambridge, USA, 2014.
- [4] Shwetha R., Naveen Kumar, and Priya S., "Human Detection Robot Using PIR Sensor and GSM Technology," *International Journal of Engineering Research and Applications (IJERA)*, vol. 4, no. 6, pp. 78–82, 2014.
- [5] M. K. Mishra and P. K. Sinha, "Role of Robotics in Disaster Management," *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering*, vol. 3, no. 5, pp. 9500–9505, 2014.
- [6] Atmel Corporation, *ATmega328/P Datasheet*, Microchip Technology Inc., 2018.
- [7] Digi International Inc., *XBee/XBee-PRO ZigBee RF Modules User Guide*, Digi International, USA, 2019.
- [8] Muhammad Ali Mazidi, Sarmad Naimi, and Sepehr Naimi, *The AVR Microcontroller and Embedded Systems Using Assembly and C*, Pearson Education, 2011.
- [9] Simon Monk, *Programming Arduino: Getting Started with Sketches*, McGraw-Hill Education, 2016.
- [10] Charles Platt, *Make: Electronics – Learning Through Discovery*, Maker Media Inc., 2015.
- [11] S. Nagar et al., "Review and Explore the Transformative Impact of Artificial Intelligence (AI) in Smart Healthcare Systems," in *2024 International Conference on Advances in Computing Research on Science Engineering and Technology (ACROSET)*, Indore, India, 2024, pp. 1–5. doi:10.1109/ACROSET62108.2024.10743527.
- [12] J. Singh and P. Singh, "Image Forgery Detection Using Deep Neural Networks," in *Proceedings of the IEEE International Conference on Signal Processing, Communications and Computing*, 2021.
- [13] M. Patidar et al., "A Deep Learning Approach to Improving Patient Safety in Healthcare Using Real-Time Face Mask Detection," in *2024 International Conference on Advances in Computing Research on Science Engineering and Technology (ACROSET)*, Indore, India, 2024, pp. 1–6. doi:10.1109/ACROSET62108.2024.10743262.
- [14] R. Yadav, P. Moghe, M. Patidar, V. Jain, M. Tembhurney, and P. K. Patidar, "Performance Analysis of Side Lobe Reduction for Smart Antenna Systems Using Genetic Algorithms (GA)," in *2023 14th International Conference on Computing Communication and Networking Technologies (ICCCNT)*, Delhi, India, 2023, pp. 1–5. doi:10.1109/ICCCNT56998.2023.10306796.
- [15] R. Sarang, M. Patidar, and A. Shah, "Deep Learning-Based Breast Cancer Detection Using Fine-Tuned CNN," *PiCET 2025*, Vadodara, India, 2025, pp. 222–227. doi:10.1049/icp.2025.1298.
- [16] V. Chauhan et al., "Deep Learning Solution for Detecting Fake News," *PiCET 2025*, Vadodara, India, 2025, pp. 56–63. doi:10.1049/icp.2025.1277.
- [17] N. Gupta et al., "Predictive Insights: Leveraging Artificial Intelligence for Strategic Business Decision-Making," *Advances in Consumer Research*, vol. 2, no. 5, pp. 98–105, 2025.
- [18] M. Adawadkar, "AI-Powered Detection of Deceptive Product Feedback: A Review of Methods, Models, and Future Directions," *International Journal of Trend in Scientific Research and Development*, vol. 9, no. 5, pp. 648–656, Oct. 2025. [Online]. Available: www.ijtsrd.com/papers/ijtsrd97583.pdf
- [19] K. Dave et al., "A Comprehensive Fraud Detection System Based on Client Transaction History and Behavioral Data Analysis," in *2025 IEEE 5th International Conference on ICT in Business Industry & Government (ICTBIG)*,

- Indore, India, 2025, pp. 1–5.
doi:10.1109/ICTBIG68706.2025.11323815.
- [20] R. Khan, M. Adawadkar, P. S. Dhoni, and M. S. Pandey, “Ensuring Data Coherence across Enterprise Systems and AI,” in *2025 IEEE 7th International Conference on Computing, Communication and Automation (ICCCA)*, Greater Noida, India, 2025, pp. 1–8.
doi:10.1109/ICCCA66364.2025.11325219.
- [21] S. Parikh, “Next-Generation Vehicle Accident Prevention and Detection Using Intelligent Control Systems,” *International Journal for Research in Applied Science and Engineering Technology (IJRASET)*, pp. 374–387, 2025.
doi:10.22214/ijraset.2025.71521.
- [22] S. Parikh, “Green Energy Innovations: Alternatives to Fossil Fuels,” *Journal of International Research in Engineering and Management (JOIREM)*, vol. 5, no. 6, Jun. 2025. [Online]. Available: <https://joirem.com/articles-page/?id=4997>
- [23] S. Parikh, “The Future of E-Commerce Fulfillment: Harnessing Advanced Robotics and System Optimization in U.S. Retail,” *International Journal of Scientific Research in Engineering and Management (IJSREM)*, vol. 9, no. 2, pp. 1–9, Feb. 2025.
- [24] S. Parikh, “Integration and Optimization of Hybrid Solar-Wind Energy Systems: A Technological Perspective,” *International Journal of Scientific Research and Engineering Development (IJSRED)*, vol. 8, no. 1, pp. 644–651, 2025.

